SAT SCD/ARGOS
INSTRUCTION MANUAL

REVISION: 1/03

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SAT SCD/ARGOS Table of Contents

1. Overview 1

1.1 Physical 2
1.2 Electrical 2

2. Programming the Datalogger 3

2.1 Data Packets 3
2.2 Data Packet Transmission 3
2.3 Datalogger Instruction 125 4
2.3.1 The Active Storage Area 4
2.3.2 New Data 4
2.3.3 P125 Result Codes 4
2.3.4 Using Result Codes In the Program 5
2.3.5 When to Execute P125 5
2.4 Program Example 5

3. SAT SCD/ARGOS Configuration 7

3.1 SAT SCD/ARGOS Power Supply 7
3.2 Pttcomm.exe 7
3.2.1 Loading the Configuration to the PTT 8

4. Satellite Orbit Patterns 8

5. Antenna Placement 9

Figures

1-1 SAT SCD/ARGOS 1
1-2 SAT SCD/ARGOS with Enclosure 3
5-1 Complete Weather Station with PTT 9

Table

2-1 P125 Result Codes 5

SAT SCD/ARGOS

1. Overview

The SAT SCD/ARGOS certified PTT satellite transmitter is well suited for remote data collection applications. Service Argos data transceivers fly aboard two or more of NASA's polar orbiting environmental satellites (POES). The SCD center carrier frequency is 401.620 MHz, the Argos center carrier frequency is 401.650 MHz. Channel spacing is 500 Hz. With an orbit altitude close to 800 kilometers, the satellites are at a relatively low orbit. The low orbit allows for a smaller antenna and power supply. The orbit period is approximately 1 hour and 45 minutes for each satellite. This orbit period allows hourly data transmission at extreme northern and southern latitudes. Near the equator there are about six POES satellite passes per day, but they are not evenly spaced. Each data transmission can include up to 32 bytes, or 16 Campbell Scientific data points. Data must be decoded by the user. SCD satellites follow an equatorial orbit, with satellite passes approximately every two hours.

The SAT SCD/ARGOS PTT supports up to four Argos ID numbers and four SCD2 ID numbers. Message repeat intervals, ID numbers and duty cycles can be changed with a simple-to-use computer-based interface. The transmitter connects directly to the CS I/O port using the standard SC12 ribbon cable. All power and input/output connections with the datalogger are through the CS I/O port. Power requirements can be as low as 2 mA average current drain. After power is applied, the PTT will start to transmit at the repeat interval. If the datalogger has not sent data to the transmitter, a default message is sent. During configuration, transmissions are disabled. Program instruction P125 is used to send final storage data to the transmitter. The CR10X datalogger supports the SAT SCD/ARGOS.

FIGURE 1-1. SAT SCD/ARGOS

1.1 Physical

The SAT SCD/ARGOS PTT is housed in an aluminum enclosure measuring 3" x 2.75" x 1". There are two electrical connections. The DB9 port connects to the datalogger CS I/O port. The SMA female port connects to the 50 ohm impedance antenna.

1.2 Electrical

The SAT SCD/ARGOS PTT uses the Campbell Scientific Synchronous Device for Communication (SDC) protocol. The SDC port (DB9 connector) connects directly to the datalogger serial port (CS I/O), using the supplied SC12 ribbon cable. The SDC protocol allows other SDC devices to be connected to the same serial port. Power is supplied via the SC12 cable, pin 1 and pin 8.

NOTE Not all CR10X wiring panels supply 12 volts to pin 8. The CR10X wiring panel must include the text: "CR10X wiring panel".

The RF connector is an SMA female; nominal output impedance is 50 ohms. Transmit power is typically one watt. The antenna is omnidirectional, which is necessary because the target satellites are not geostationary. The Argos center frequency is 401.650 MHz; the SCD2 center frequency is 401.620 MHz. Channel spacing is 500 Hz.

The SAT SCD/ARGOS SDC port pin out:

Pin number	Function
1	+5 volts
2	Ground
3	NC
4	TXD (data out)
5	NC
6	SDE (input)
7	CLK/HS (input)
8	+12 volts
9	RXD (data in)

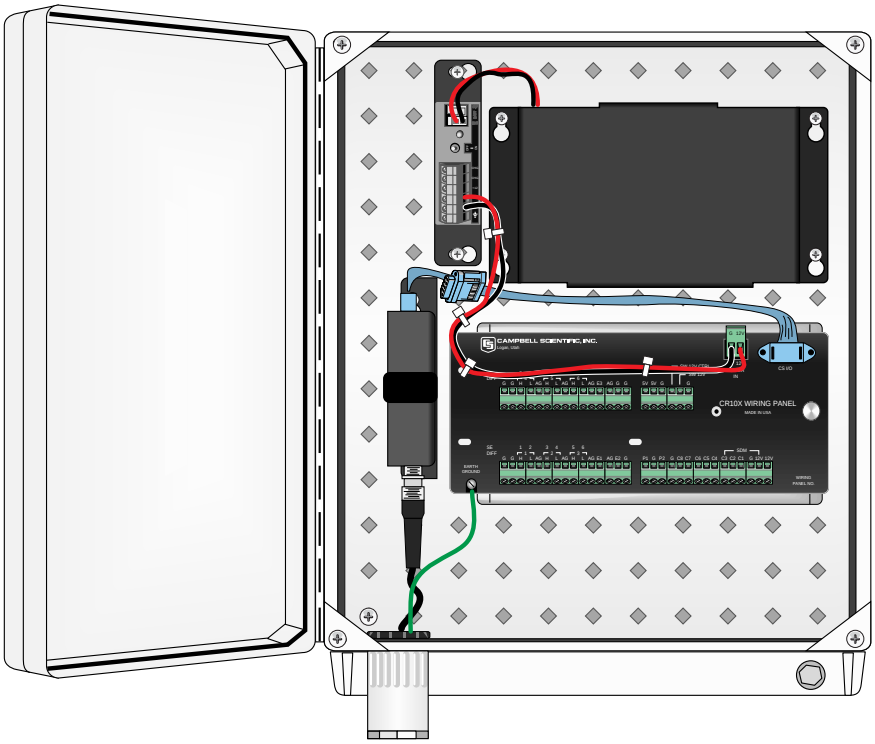

FIGURE 1-2. SAT SCD/ARGOS with Enclosure

2. Programming the Datalogger

2.1 Data Packets

Before programming the datalogger, you must determine how much data you will be sending. Each data packet holds 32 bytes; each data point uses two bytes. With each data point using 2 bytes, you can send 16 data points in each data packet. The Array ID is not sent. If you are writing a time stamp to final storage, don't forget to include the time stamp as additional data points. The SAT SCD/ARGOS can hold up to four data packets. Each data packet is transmitted as a single message. High resolution data points are four bytes, but high resolution data are not supported by the P125 SAT SCD/ARGOS program instruction.

2.2 Data Packet Transmission

When you setup your Service Argos account and SCD account, you will select a message repeat interval. The PTT will repeat the message at the repeat interval until a new message is loaded into the PTT. The Argos transmissions will be offset from the SCD transmissions by half of the repeat interval if the repeat interval is the same for both SCD and Argos.

When sending one data packet of 16 data points, the PTT will repeat the data packet at the repeat interval. When sending two data packets of 16 data points each, total of 32 data points, the PTT will alternate between each data packet. If you send four data packets, the PTT will send packet one, wait the repeat interval, send packet two, wait the repeat interval, send packet three, wait the repeat interval, send packet four, wait the repeat interval, and start over with packet one.

2.3 Datalogger Instruction 125

The datalogger uses P125 to send data to the PTT. All new data, up to 64 data points, in the active storage area, are sent to the PTT. New data is all data that has been written to the active final storage area since P125 last executed. If there are more data than 64 data points (4 data packets times 16 data points), P125 does not send the extra data. The extra data will be sent the next time P125 is executed. You must not continuously write more data to the active final storage area than you can send over Argos. The datalogger does not erase data after it has been sent to the transmitter.

2.3.1 The Active Storage Area

The datalogger has two final storage areas, final storage area 1 (FS1) and final storage area 2 (FS2). Program instruction 80 is used to set the active storage area. By controlling where data is written and what storage area is active when P125 executes, you can keep two separate data files. This can be useful if you want to collect and store more data than you can transmit. FS1 is the default storage area. The datalogger always defaults to FS1 at the top of the program table. If you plan to use FS2, you must allocate memory to FS2. Memory for FS2 can be allocated in Edlog; click on “Options/Final Storage Area 2”.

2.3.2 New Data

The datalogger must keep track of what data has been sent to the PTT and what data has not. To track new data, the datalogger keeps several data storage pointers. The Data Storage Pointer (DSP) points to the first location past the last data value in final storage. The Satellite Pointer points to the first data location that was written since P125 last executed. When P125 executes successfully, all new data is transferred and the satellite pointer is updated and points to the DSP, or 1 data location past the last data value sent to the PTT.

2.3.3 P125 Result Codes

Program instruction 125 returns a result code to the input location specified in P125. The result code can be used to determine if P125 executed successfully. Under certain circumstances the datalogger cannot properly execute P125; for example, the PTT blocks communications while transmitting. Result codes can be used to determine if you need to execute P125 again. See Table 2-1 for result codes.

2.3.4 Using Result Codes in the Program

After P125 has executed, check the result codes. If the result code is greater than or equal to two, execute P125 again. Recheck the result code on the next pass of the program table. Example Algorithm:

```
If  time to write data
      Write data to Final Storage
      Execute P125
Use P89 to determine if result code >= 2
      If true execute P125
end (P95)
```

2.3.5 When to Execute P125

Usually P125 is only executed after data has been written to final storage. While this is not critical, it makes more sense. When P125 sends new data to the PTT, all data in the PTT is replaced. If P125 is executed when there is no new data in final storage, P125 returns a result code of 1. Existing data is not removed from the PTT.

TABLE 2-1. P125 Result Codes

Result Code	Code Meaning
0	Normal response, transmitter on line and data packet received
1	No new data in datalogger active final storage area
2	No response from the transmitter, transmitter may be transmitting
3	Improper response from transmitter
4	Data packet not properly received by transmitter
5	Transmitter timed out before data packet was received
6	Datalogger serial port not available, probably in use by another device

2.4 Program Example

```
;{CR10X}
;
*Table 1 Program
  01: 10            Execution Interval (seconds)

; Load values in input locations

1:  Bulk Load (P65)
  1:  11            F
  2:  22            F
  3:  33            F
  4:  44            F
  5:  55            F
  6:  66            F
  7:  77            F
  8:  88            F
  9:  3             Loc [ Start_1   ]
```

```
; Load more values in input locations

2:  Bulk Load (P65)
   1:   99              F
   2:   101             F
   3:   102             F
   4:   103             F
   5:   104             F
   6:   105             F
   7:   106             F
   8:   107             F
   9:   11              Loc [ Start_9   ]

; If top of the hour, write 16 data point to FS1

3:  If time is (P92)
   1:   0               Minutes (Seconds --) into a
   2:   60              Interval (same units as above)
   3:   10              Set Output Flag High (Flag 0)

4:  Real Time (P77)
   1:   1220            Year,Day,Hour/Minute (midnight = 2400)

5:  Sample (P70)
   1:   13              Reps
   2:   3               Loc [ Start_1   ]

; If top of the hour, transfer all new data to the SAT SCD/ARGOS transmitter

6:  If time is (P92)
   1:   0               Minutes (Seconds --) into a
   2:   60              Interval (same units as above)
   3:   30              Then Do

7:  SCD2/ARGOS (P125)
   1:   19              Return Code Loc [ R_Code    ]

8:  End (P95)

; Check result of P125, if greater than 1 execute P125 again

9:  If (X<=>F) (P89)
   1:   19              X Loc [ R_Code    ]
   2:   3               >=
   3:   2               F
   4:   30              Then Do

10:  SCD2/ARGOS (P125)
   1:   19              Return Code Loc [ R_Code    ]

11:  End (P95)

*Table 2 Program
   02: 0.0000       Execution Interval (seconds)

*Table 3 Subroutines

End Program
```

3. SAT SCD/ARGOS Configuration

The SAT SCD/ARGOS PTT must be configured before you deploy it. Two numbers are used to track your data through the system. The first number is your Program ID, the second number is your SCD/Argos ID. The PTT can use up to 4 SCD numbers and up to 4 ARGOS ID numbers. You must have your SCD/Argos ID numbers before you can configure your PTT. The SCD/Argos ID number and transmission repetition rate is written to the SAT SCD/ARGOS PTT during configuration.

3.1 SAT SCD/ARGOS Power Supply

During configuration, the PTT is powered through the SC532A. For a power supply the SC532A uses a 12 volt DC wall regulator/transformer or a direct connection to a 12 volt battery. The SC532A has an internal jumper. The jumper changes the operational mode of the SC532A. In the "PROG" or program mode, the SC532A will provide the interface between a computer and the SAT SCD/ARGOS. The SC532 mode is used for storage modules. When using the SC532A to configure the SAT SCD/ARGOS transmitter, configure the jumper for "PROG".

NOTE The SC532 will not work in place of the SC532A.

3.2 Pttcomm.exe

Included with each SAT SCD/ARGOS is a disk containing support software. The information on the disk should be copied to a computer. Load the disk in the disk drive and execute "Setup.exe".

The computer must have a working RS 232 port. Pttcomm.exe is a 32 bit windows-based program. Run Pttcomm.exe; use "File/Open" to open the configuration file "SCD_Argos.cfg".

Edit your SCD/Argos ID number, or numbers if you are using more than one. By setting an ID number to zero, the buffer is turned off. All buffers not being used should be set to zero.

Scroll down to "SCD Transmission Rep Rate" and "Argos Transmission Rep Rate". Enter the appropriate repetition rate for each field.

The Argos channel number and SCD2 channel number can be set to a value between 0 and 10. Channel 5 is the center channel.

In most cases, "Transmission On Time" and "Transmission Off Time" will not need to be changed. Transmission on time is the time the transmitter continues to send bursts of data at the transmission repetition rates. Transmission off time is the amount of time the PTT is shut down after the transmission on time has been completed. Transmission on/off time starts when the PTT is powered up. Transmission on and off time can be used to control the duty cycle of the transmitter. The transmission off time is not synchronized with the time of day.

The shut down timer will turn the PTT off after the shut down time has expired. The PTT will not turn back on. Set the shut down timer to zero for extended operation.

Save the configuration file to a new name. From the PTTComm menu bar, select File, Save As and save the file to a new name. You may need the original configuration file at a later date.

3.2.1 Loading the Configuration to the PTT

Assemble the hardware. You need the SAT SCD/ARGOS PTT, the SC532A with power supply, and two serial cables (SC12). Before you apply power, you should have a dummy load or antenna connected to the RF output of the SAT SCD/ARGOS. Do not apply power to the SAT SCD/ARGOS yet. Make the following connections:

1) PTT to SC532A using the SC12 ribbon cable.
2) SC532A to the PC using an RS232 cable.
3) Antenna or dummy load to the PTT RF output.
4) Connect AC transformer/12 volt DC supply to power source, but don't connect to the SC532A.

After power is applied to the PTT, it will start to transmit. Don't let the PTT transmit until you have the configuration loaded. Many times a transmission from inside a building will be picked up by a satellite. To avoid unwanted transmissions, do not apply power to the PTT before the configuration program (Pttcomm.exe) is ready.

On the PC, load Pttcomm.exe. Click "File/preferences". Set the correct communications port. Also, set the baud rate to 9600. Everything else should be left to the default values of: UI Exit string = QQQQQQG, Platform = WildCAT, Prompt Wait (In Seconds) = 70, Verify data as it is Written and Simple Mode not checked.

Click on file and open the configuration file "SCD_Argos.cfg", if it is not already open.

Click on the start button. Apply power to the SC532A; this will power the transmitter. When the PTT is first powered, it sends a start up message out the serial port. When Pttcomm.exe receives a startup message, the PTT is put in configuration mode. Pttcomm.exe will give a message when the PTT and the computer have established communications. Click on the "Cfg" button to send the configuration file. In a moment the software will acknowledge the file was sent. Wait at least ten seconds before you close Pttcomm.exe or power down the PTT.

4. Satellite Orbit Patterns

At least two POES satellites carry the Argos transceivers and are operational at any given time. The orbits carry the satellites over the North and South poles of the earth in a sun synchronous pattern. Orbit period is close to 102 minutes. The satellite footprint is about 5000 km in diameter. At latitudes greater than 75 degrees, each satellite provides coverage each pass. Each satellite passes

over the poles 14 times a day providing 28 satellite passes per day. Coverage decreases with latitude. At the equator the PTT will "see" a satellite six or seven times a day. The SCD2 satellites are in a different orbit pattern than the POES satellites.

The duration of the POES satellite visibility depends on the angle from the PTT to the satellite. If the satellite passes directly overhead, the satellite will be visible for about 15 minutes. If the satellite passes close to the horizon, as viewed from the PTT, the satellite will only be visible for a short time. On average, each satellite pass is visible for about ten minutes. If using a 200 second repetition rate, a satellite pass could result in three received messages from the PTT.

Satellite coverage must be considered when planning data collection and transmission. Given the variability of satellite coverage, hourly data cannot be expected unless the PTT is located above 75 degrees latitude. The number of successful data transmissions per satellite pass will increase with a decrease in the repetition rate.

More detailed information regarding Service Argos and satellite coverage is available from Service Argos. On the Web, see http://www.argosinc.com/. The Service Argos North American office can be contacted by email at useroffice@argosinc.com or phone (301) 925-4411.

5. Antenna Placement

The position of polar orbiting satellites relative to the PTT will change during the satellite pass and with each satellite pass. The antenna must broadcast evenly to all areas of the sky. The antenna is omnidirectional. Mount the antenna vertically. Choose a location with a clear view of the sky in all directions. Any obstruction between the PTT antenna and the sky can block data transmission between the satellite and the PTT.

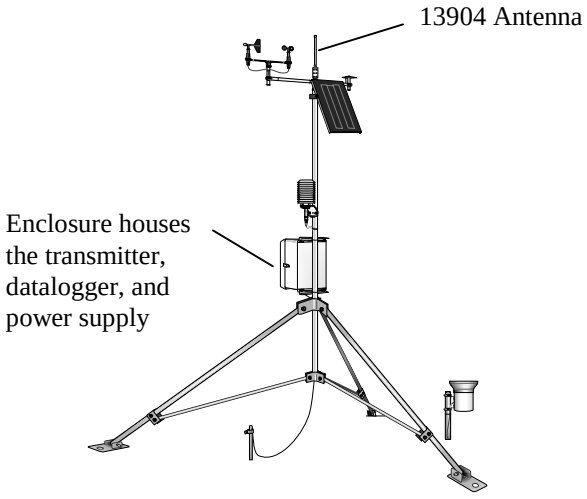

FIGURE 5-1. Complete Weather Station with PTT